ABSTRACT

Tractor is the most important source of power and irreplaceable use in the agricultural field. Due to poor management of tractor-implement combinations, the maximum power of the tractor is not being utilized to the possible extent. These issues can be minimized by the proper management of tractors and machinery through precise monitoring of performance-related data. Therefore, the present study was conducted to develop a telematics system for real-time measurement, storage, and visual presentation of different field performance parameters of any given implement attached to the tractor with a high degree of accuracy.

An embedded unit of telematics system was developed for real-time measurement of various performance parameters i.e. actual speed, wheel slip, depth of operation, fuel consumption, draft, PTO torque, and geo-location of a tractor-implement combination. A strain gauge-based PTO torque transducer was designed and developed to measure the PTO torque requirement of the tractor. The telematics system is also composed of a visual interface-cum-embedded system and mobile as well as web-based responsive application to acquire, display and store the real-time values of mentioned performance parameters.

The depth sensing unit of the developed telematics system was validated and maximum value of MAPE of 4.17 % revealed that the developed sensing unit was efficient and accurate. Fuel consumption measuring unit was tested and it was observed that fuel consumption varied from 5.98 L/h to 7.94 L/h and 4.97 L/h to 6.93 L/h during operation with M.B. Plough and cultivator respectively. Performance of the load cell-based dynamometer was found to be accurate and efficient. A variation in coefficient of non-uniformity (CNU) in the range of 1.22 % to 8.55 % and 1.07 % to 2.17 % was observed during operation of M. B. Plough and cultivator respectively. Hall effect sensor-based sensing unit for actual speed measurement was tested and a small range of MAPE (3.57 % to 11.61 %) indicated that the developed unit was accurate and stable for actual speed measurements. The CNU and MAPE of wheel slip measurement varied from 4.16 % to 11.34 % and 7.25 % to 11.99 % during operation with M. B. Plough while they varied from 2.40 % to 9.75 % and 3.40 % to 9.23 % during operation with cultivator. The developed PTO torque transducer was evaluated in actual field conditions with rotavator and it was observed that the MAPE varied from 8.64 to 15.55 % at different depths of operation. The obtained results of PTO torque were also compared with the predicted torque values computed using the Bernacki et al., (1972) model and Ghosh (1967) model and a non-significant difference was observed between the measured and predicted torque. A separate embedded system was developed to track the real-time position of the test tractor in Google Maps. The developed system shows the real-time position of the tractor on Google Maps in the form of an array of red points that represent the coordinates of the position on the earth's surface.

Keywords: Telematics system, Embedded unit, Visual interface, PTO torque, Hall effect sensor, Dynamometer